ZooKeys 1075: 175–198 (2021)
doi: 10.3897/zookeys.1075.73318
https://zookeys.pensoft.net

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A contribution to the knowledge of cave-adapted ground beetles from Guiyang, central Guizhou Province, southwestern China (Coleoptera, Carabidae, Trechini)

Mingyi Tian[1], Guangyuan Cheng[2], Sunbin Huang[1,3]

1 *Department of Entomology, College of Plant Protection, South China Agricultural University, 483 Wushan Road, Guangzhou, 510642, China* **2** *Haixia Caving, Bureau of Ecology and Environment, no. 7 Building, Financial City, Guanshanhu, Guiyang, Guizhou, 550081, China* **3** *Mécanismes adaptatifs et évolution (MECADEV), UMR 7179 CNRS–MNHN, Muséum national d'Histoire naturelle, CP50, 57 Rue Cuvier, F–75005 Paris, France*

Corresponding author: Mingyi Tian (mytian@scau.edu.cn)

Academic editor: T. Assmann | Received 21 August 2021 | Accepted 17 November 2021 | Published 7 December 2021

http://zoobank.org/E78D8970-2BE5-424F-A4F1-B77E009B4154

Citation: Tian M, Cheng G, Huang S (2021) A contribution to the knowledge of cave-adapted ground beetles from Guiyang, central Guizhou Province, southwestern China (Coleoptera, Carabidae, Trechini). ZooKeys 1075: 175–198. https://doi.org/10.3897/zookeys.1075.73318

Abstract

A new genus and two new species of cavernicolous trechines are reported from central Guizhou Province, southwestern China. *Haixiaphaenops* **gen. nov.** is established to place a new species discovered in two limestone caves in northern Qingzhen Shi: *H. jinxiaohongae* **sp. nov.** (Dawan Dong cave and Changtu Dong and Dawan Dong caves). This new genus is allied to *Zhijinaphaenops* Uéno & Ran, 2002. *Zhijinaphaenops zhaofeii* **sp. nov.** is described from Zhangkou Dong cave in northern Jiuzhuang Zhen of Xifeng County. In addition, two new localities of the species *Zhijinaphaenops jingliae* Deuve & Tian, 2015, and two new localities of *Sinaphaenops chengguangyuani* Ma et al. 2020 are provided. A distribution map for all cavernicolous trechine beetles known in Guiyang is provided.

Keywords

Hypogean, new genus, new species, semi-aphaenopsian, trechines

Copyright *Mingyi Tian et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Undoubtedly, Guizhou is the province harbouring the richest cave specific diversity in China in terms of hypogean trechine beetles (Tian et al. 2016, 2020; Chen et al. 2017; Huang et al. 2020; Tian et al. 2021). Of the 168 cave species of trechines known in China, 62 are occurring in Guizhou Province. But the subterranean fauna of ground beetles is poorly studied in Guiyang Shi, central Guizhou. Only three species in two genera of cave-adapted trechines have been reported from this area. The genus *Zhijinaphaenops* Uéno & Ran, 2002 was formerly described from Zhijin County, Bijie Shi, central Guizhou, then reported from several other counties, viz. Dafang, Xifeng, Zunyi, and Weng'an. Nine species are included in the genus so far (Uéno and Ran 2002; Deuve and Tian 2015, 2018). Among them, two species were recorded from Xifeng County, Guiyang Shi: *Zhijinaphaenops jingliae* Deuve & Tian, 2015 and *Z. liuae* Deuve & Tian, 2015.

Sinaphaenops Uéno & Wang, 1991 is a large genus, composed of 13 species so far, ranging in southern Guizhou and also extending to Huanjiang County, northern most Guangxi (Uéno and Wang 1991; Uéno and Ran 1998; Uéno 2002; Deuve and Tian 2014; Chen et al. 2017; Ma et al. 2020). Amongst them, only *S. lipoi* Chen et al. 2020 is known from Guiyang (Chen et al. 2020).

Led by Guangyuan Cheng, the second author, the local cavers from the Haixia Caving (a cave exploration team in Guiyang) have begun to carry out biological surveys in recent years. They have visited many limestone caves in central Guizhou Province and discovered some interesting cavernicolous ground beetles (Fig. 1). For instance, *Sinaphaenops chengguangyuani* Ma et al. 2020 was formerly found by them in a limestone cave in Longli County of Qiannan Buyi & Maio Autonomous Prefecture, close to Guiyang (Ma et al. 2020). Two more localities, from Guiyang and Longli respectively, of this beautiful species are now confirmed. In Xifeng County, they discovered two other caves where *Zhijinaphaenops jingliae* is living. In Qingzhen Shi, they found two beetle individuals in the cave Dawan Dong and another beetle in the cave Changtu Dong. These beetles are members of an undescribed species belonging to an unknown genus allied to *Zhijinaphaenops*.

Hence, we establish a new genus to accommodate the new species found in the caves Dawan Dong and Changtu Dong, describe a new *Zhijinaphaenops* species from the cave Zhangkou Dong in Xifeng County and provide new localities for *Zhijinaphaenops jingliae* and *Sinaphaenops chengguangyuani* in the suburbs of Guiyang, the capital city of Guizhou Province.

Materials and methods

The beetle specimens were collected in caves by hand or by using an aspirator, and kept in vials with 50% ethanol. One exemplar of each species was placed into 95% ethanol for DNA sequencing. Dissections and observations were made by using a Leica MZ75 dissecting stereomicroscope (Wetzlar, Germany). Dissected genitalia, including the

median lobe and parameres of aedeagus, were glued on small transparent plastic cards and pinned under the specimen from which they were removed. Digital pictures were taken using a Canon EOS 5D Mark III camera (Tokyo, Japan), and then processed by means of Adobe Photoshop CS5 software (Adobe System Incorporated, California, USA).

Measurements and terminologies used in the text follow Tian et al. (2016). The abbreviations used in the text are as follow:

HLm length of head including mandibles, from apex of right mandible to occipital suture;
HLl length of head excluding mandibles, from front of labrum to occipital suture;
HW maximum width of head;
PrL length of prothorax, along the median line;
PnL length of pronotum, as above;
PrW maximum width of prothorax;
PnW maximum width of pronotum;
PfW width of pronotum at front;
PbW width of pronotum at base;
EL length of elytra, from base of scutellum to elytral apex;
EW maximum width of combined elytra.

All material is deposited in the insects collection of South China Agricultural University, Guangzhou, China (SCAU).

Taxonomy

Tribe Trechini Bonelli, 1810

***Haixiaphaenops* gen. nov.**
http://zoobank.org/7BBA8EF9-21D8-460D-A361-CC134DF019CD
(Chinese name: 海峡盲步甲属)

Type species: *Haixiaphaenops jinxiaohongae* sp. nov. (caves Dawan Dong and Changtu Dong, Qingzhen, Guiyang)

Generic characteristics. Medium-sized cave trechine, depigmented and eyeless, semi-aphaenopsian; body stout though fore body elongated, with moderately elongated appendages. Head longer than wide, 2 pairs of supraorbital setiferous pores present; frontal furrows rather long, incomplete, parallel-sided in most part, divergent posteriad; mandibles thin and very elongated, moderately hooked apically, right mandibular tooth bidentate though with 2 additional tiny denticles medially; labial suture absent; mentum 2-setose, base widely concave, submentum 10-setose; antennae thin and rather long, extending to apical 1/3 to 1/4 of elytra. Prothorax strongly convex and propleura notably visible from above; pronotum, much longer than wide,

subparallel sided, disc covered with long setae, presence of only anterior lateral setae. Elytra elongated ovate, much wider than fore body; widest before middle, without humeral angles; base bordered, lateral margins well-bordered and ciliate throughout; disc extremely convex and tumid, partly concealing lateral margins; striae noticeable though punctures faint, intervals slightly convex; 3 discal setiferous pores present on each elytron, the preapical pores absent; the humeral group of the marginal umbilicate pores not aggregated, 1st pore inwardly and backwardly shifted, 5th and 6th pores (middle group) moderately spaced. 1st protarsomere dilated and elongated in male, inwardly spurred at apex; abdominal ventrite VII 6-setose in male.

Remarks. *Haixiaphaenops* gen. nov. is allied to the genus *Zhijinaphaenops* Uéno & Ran, 2002 by sharing the following characteristics: (1) mentum and submentum completely fused; (2) prothorax strongly dilated and propleura notably visible from above, pronotum with only anterior latero-marginal setae; (3) only protarsomere 1 modified in male, which is long and inwardly spurred at apex; (4) pronotum covered with long setae; (5) elytra shortly pubescent, with hardly distinguishable striae, and the 1st marginal umbilicate pore inwardly and backwardly shifted, located behind the level of the 3rd pore. However, *Haixiaphaenops* gen. nov. readily differs from *Zhijinaphaenops* in several generic-level characters, such as: (1) 2 pairs of frontal pores present in *Haixiaphaenops* gen. nov., versus only the posterior pores present in *Zhijinaphaenops*; (2) antennae much shorter in *Haixiaphaenops* gen. nov., only extending at most to apical 1/4 of elytra, versus longer, projection over apices of elytra in *Zhijinaphaenops*; (3) pronotum elongated quadrate, nearly parallel-sided in *Haixiaphaenops* gen. nov., versus subcordate, not parallel-sided in *Zhijinaphaenops*; (4) elytra much stouter and more convex in *Haixiaphaenops* gen. nov., partly concealing lateral margins in median portion, versus more elongated and less convex in *Zhijinaphaenops*, with whole lateral margins visible from above; (5) base of elytra bordered in *Haixiaphaenops* gen. nov., versus unbordered in *Zhijinaphaenops*; and (6) male genitalia are small and stout, slightly bent medially, and widely rounded at apex in *Haixiaphaenops* gen. nov., versus large and slender, strongly arcuate medially, and more or less sharpened at apex in *Zhijinaphaenops*.

Etymology. "Haixia" + "Aphaenops", dedicated to Haixia Caving, a cave exploration team in Guiyang. Gender masculine.

Range. China (Guizhou). Only one species of the genus was found in the limestone caves Dawan Dong and Changtu Dong in Qingzhen, northern Guiyang Shi (Fig. 1).

Haixiaphaenops jinxiaohongae sp. nov.

http://zoobank.org/701ACD12-A45D-4794-9994-BF58B3BE90D4
(Chinese name: 晓红盲步甲)
Figures 2–7

Type material. ***Holotype*** male: Guizhou, Qingzhen, Anliu, Yangtianwo, Dawan Dong cave (贵州省清镇市暗流镇大湾洞), 26°52'N, 106°24'E, 941 m, 2020–IV–19, leg. Xiaohong Jin & Guangyuan Cheng, in SCAU; ***Paratypes:*** 1 male, same cave as holotype, 2021–VI–23, leg. Chenggang Wang; 1 male, Guizhou, Qingzhen, Anliu, Ximi,

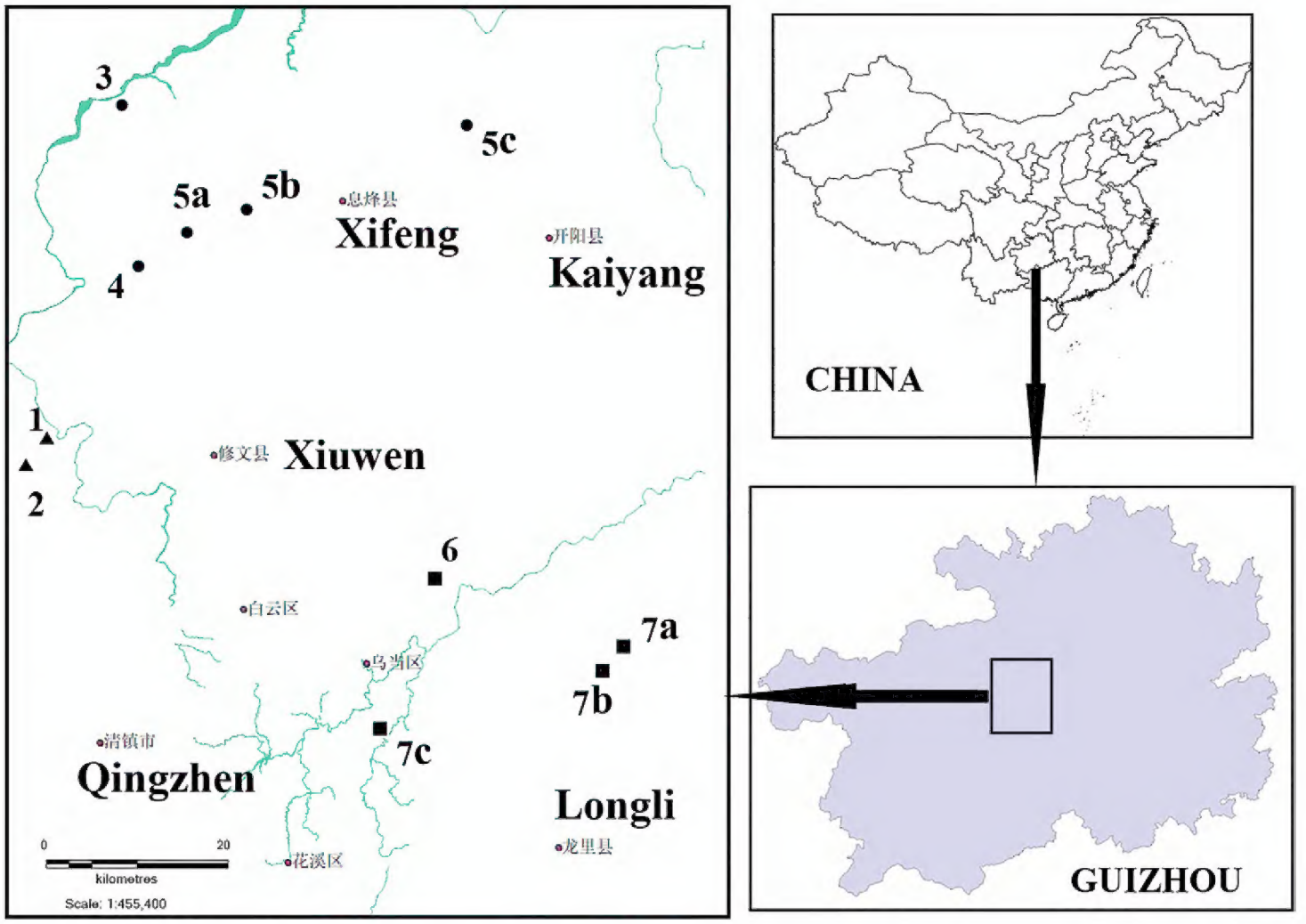

Figure 1. A distribution map of cavernicolous trechine beetles in Guiyang, central Guizhou Province. Triangles: *Haixiaphaenops* gen. nov.; dots: *Zhijinaphaenops*; squares: *Sinaphaenops* **1** *H. jinxiaohongae* sp. nov. / Changtu Dong **2** *H. jinxiaohongae* sp. nov. / Dawan Dong **3** *Z. zhaofeii* sp. nov. / Zhangkou Dong **4** *Z. liuae* Deuve & Tian, 2015 / Hejia Dong **5a** *Z. jingliae* Deuve & Tian, 2015 / Zhangkou Dong **5b** *Z. jingliae* / Mafen Dong **5c** *Z. jingliae* / Wenquan Dong **6** *S. lipoi* Chen et al. 2020 / Da Dong **7a** *S. chengguangyuani* Ma et al. 2020 / Shuijing Dong **7b** *S. chengguangyuani* / Duocai Dong **7c** *S. chengguangyuani* / Jianlong Dong.

Changtu Dong cave (贵州省清镇市暗流镇长土洞), 26°51'N, 106°21'E, 1249 m, 2020–VI–27, leg. Chenggang Wang, Xiaohong Jing, Guangyuan Cheng, Yi Zhao & Mingyi Tian, both in SCAU.

Description. Length: 6.5–6.8 mm (including mandibles); width: 1.0–1.1 mm. Habitus as in Figures 2, 3.

Head and pronotum dark brown (in holotype) or brown (in paratypes), elytra, femora and tibiae lighter, antennae, palps, and tarsi yellow. Head glabrous on upper surface, pronotum covered with long setae, elytra with short pubescence, ventral head covered with several setae; prosternum, meso- and metasterna and fore coxae glabrous, abdominal ventrites with dense and short pubescence, in particular on median portion. Microsculptural engraved meshes strongly transverse on head and pronotum, irregular isodiametric on elytra. Body moderately elongated, fore body (including mandibles) shorter than elytra.

Head (Fig. 4A, B) moderately elongated, distinctly longer than wide, HLm/HW= 2.27, HLl/HW= 1.56; widest at about middle of head from labrum; frons and vertex moderately convex, genae gently expanded anteriad (but hardly expanded in paratype

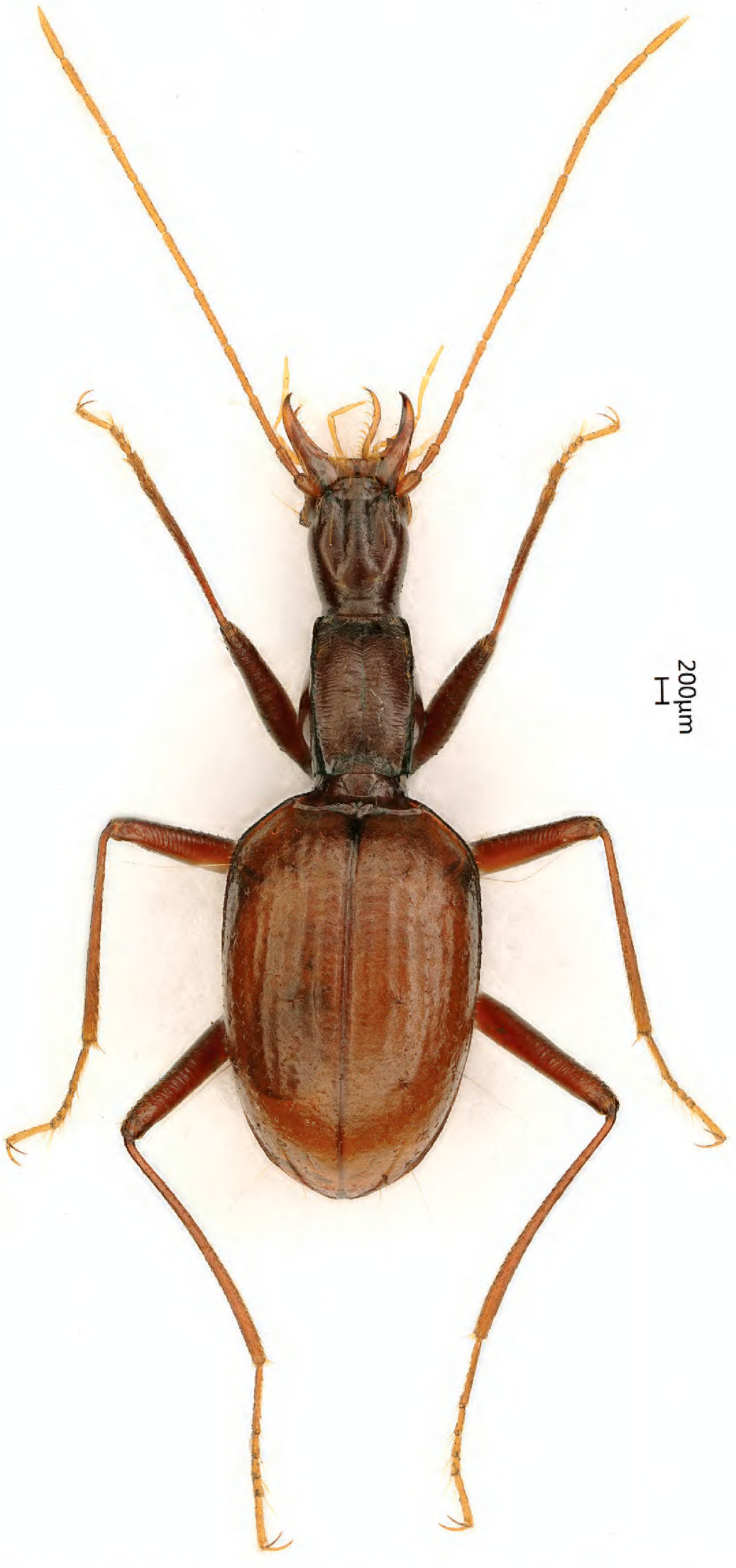

Figure 2. Habitus of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov., holotype, male

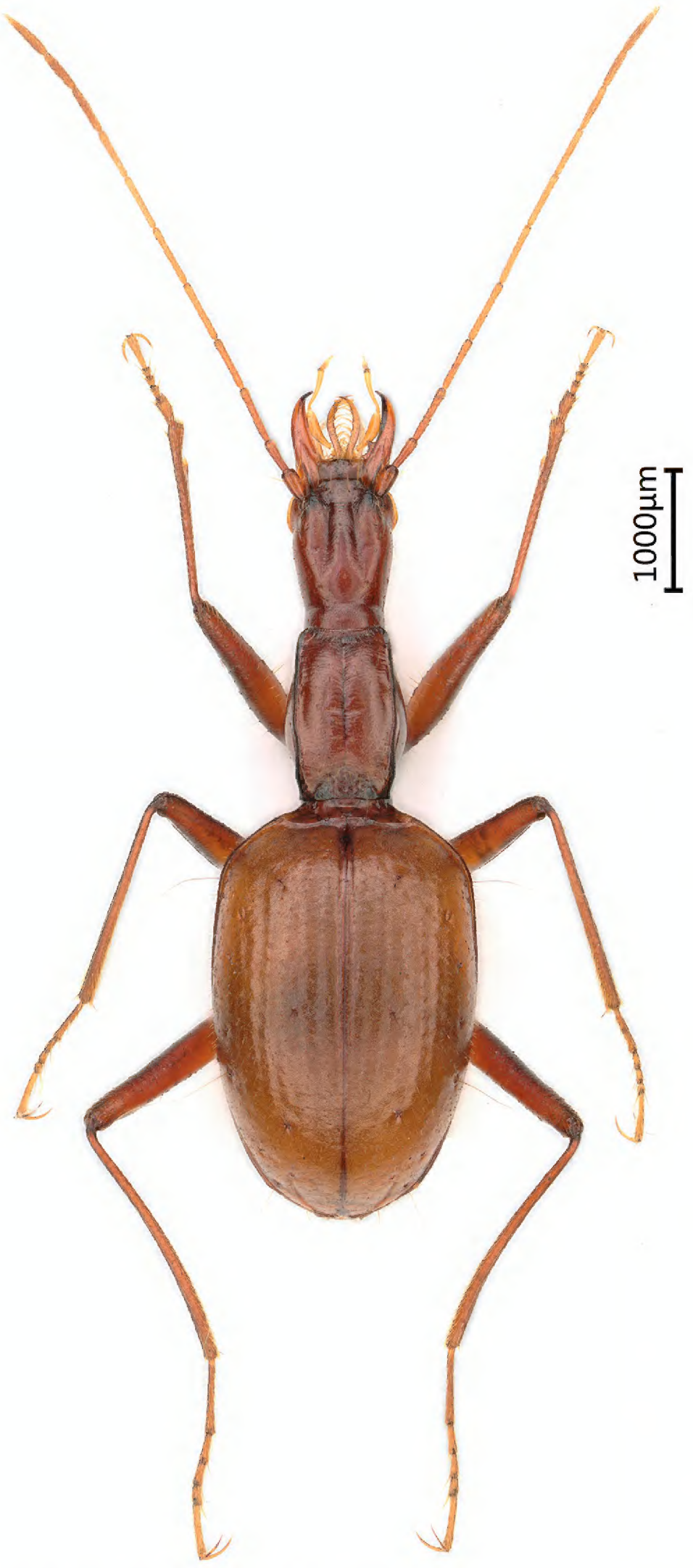

Figure 3. Habitus of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov., paratype male, from the Cave Changtu Dong

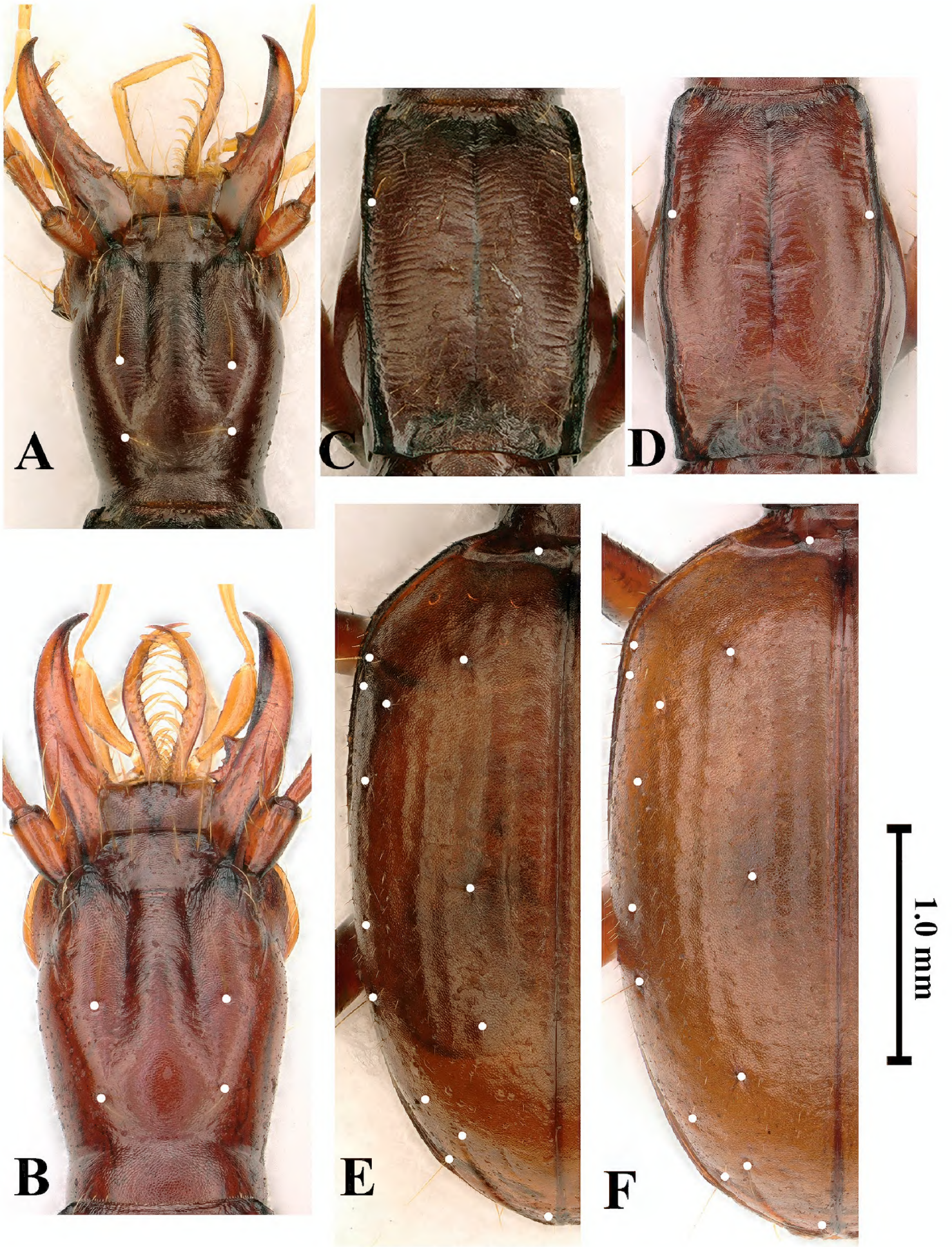

Figure 4. Shapes and chaetotaxy of head, pronotum and elytra of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov. **A, C, E** holotype from Dawan Dong **B, D, F** paratype from Changtu Dong **A, B** head **C, D** pronotum **E, F** elytra. Scale bar: 1.0 mm (**A–F**).

specimens); frontal furrows nearly parallel-sided in anterior 2/3, then strongly divergent posteriad, ending before posterior supraorbital pores; clypeus transverse, 6-setose, with an additional short seta medially; labrum transverse, nearly straight at front margin,

6-setose; mandibles thin, gently unciform at apex; labial suture absent; mentum 2-setose on each side of tooth at base, mentum base widely concave; labial tooth short, thin and bifid at tip, about half length of lateral lobe; submentum 10-setose; ligula bisetose, paraglossae pubescent; palpomeres moderately elongate, all glabrous except 2nd labial palpomere which is 4-setose (2 on inner margin and other 2 on outer margin at middle); the 2nd labial palpomere 1.3 times as long as 3rd; 3rd maxillary palpomere 1.2 times longer than 4th; suborbital pores near neck constriction; antennae slender and filiform, extending at about apical 1/4 of elytra, densely pubescent from pedicle to 11th antennomere; scape thick, fusiform, smooth but with several rather long setae, slightly shorter than pedicle; 5th and 6th antennomeres longest; antennal ratio (relative length of each antennomere compared with scape in the holotype) as follows: 1st (1.0), 2nd (1.25), 3rd (2.0), 4th (2.0), 5th (2.25), 6th (2.25), 7th (2.0), 8th (2.75), 9th (1.85), 10th (1.5) and 11th (2.0).

Prothorax (Fig. 4C, D) longer than wide, PrL/PrW = 1.25–1.45; distinctly wider than pronotum, PrW/PnW = 1.14–1.23; much shorter than head including mandibles, PrL/ HLm = 0.6–0.70, or as long as head excluding mandibles; propleura tumid, widest at about 2/5 from base. Pronotum as wide as head; much longer than wide, PnL/ PnW=1.51–1.64, widest at about middle, sides nearly parallel-sided; lateral margins distinctly reflexed throughout, front angles obtusely rectangular, hind angles sharply angulate; anterior lateral setae at about 2/7 from front margin, posterior setae absent; both base and front unbordered, the former anterior margin is subrectilinear, basal margin emarginate medially, convex laterally; disc slightly convex, surface with short and transversal striations; basal foveae large and deep, reverse triangular in shape. Scutellum short and wide.

Elytra (Fig. 4E, F) ovate and stout, much wider than prothorax, EW/PrW = 2.10–2.18, much longer than wide, EL/EW = 1.52–1.60, widest at about basal 1/3 of elytra, extraordinarily convex, lateral margins of subapical portion invisible from above; humeri broadly rounded; lateral margins ciliate throughout; base bordered; striae easily traceable though punctures absent, apical striole well marked, ended at about apical 1/7 of elytra, in the joint area of 5th and 6th striae; intervals convex; chaetotaxy: basal pores present, along both sides of scutellum at apex; three discal pores present near position of 4th stria, anterior and posterior pores at about 1/5 and 2/7 of elytra from base and from apex respectively, median pore near middle of elytra; humeral set of marginal umbilicate pores not aggregated, only 2nd and 3rd pores close to marginal gutter; 1st pore transversely and backwardly shifted to site of 6th interval, far behind level of 3rd pore, making 4th pore closer to 1st than to 3rd; locations of middle set (5th and 6th pores) behind middle of elytra, not close to each other; umbilicate seta 8 clearly visible; angulo-apical pore present.

Legs quite stout, tibiae not longitudinally furrowed; protarsi short, 1st protarsomere elongated and widened, denticulate on inner side of apex in male; 1st tarsomere shorter than, subequal to, and longer than 2nd–4th tarsomeres combined in pro-, meso- and metatarsi, respectively.

Ventrites IV with a pair, V–VI each with two pairs of paramedial setae, VII 6-setose apically in male.

Male genitalia (Fig. 5): Median lobe of aedeagus short and stout, moderately sclerotized, with a large sagittal aileron and a large and elongated copulatory piece; ventral

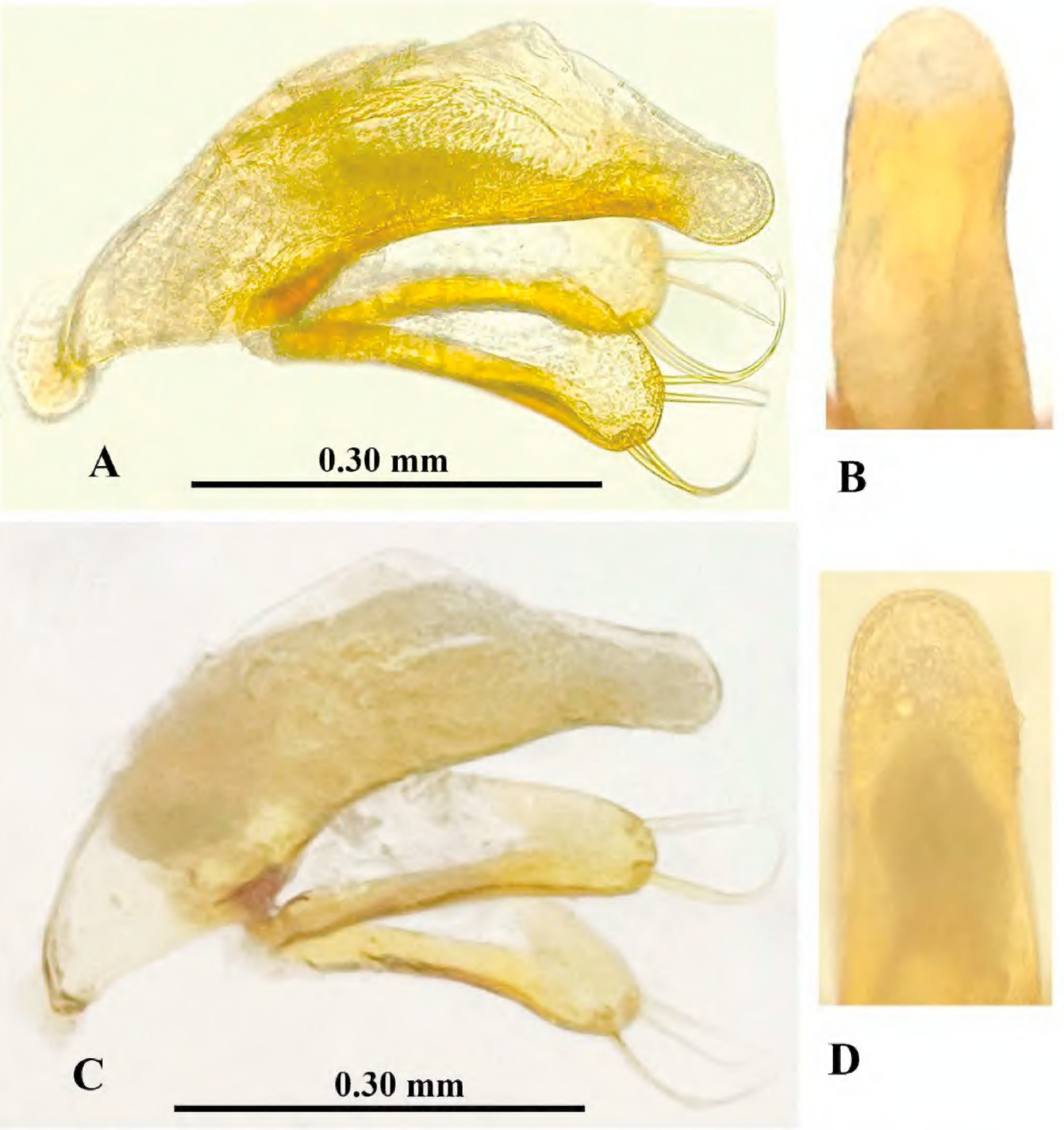

Figure 5. Male genitalia of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov. **A, B** holotype from Dawan Dong **C, D** paratype from Changtu Dong.

margin hardly sinuate, base opening wide, apex broadly rounded; parameres long and broad, but shorter than median lobe, each with four long setae at apex; in dorsal view, apical lobe rounded at apex, nearly as long as wide.

Female: unknown.

Etymology. This species is dedicated to Ms Xiaohong Jin, an active member of Haixia Caving, Guiyang, who found and collected the unique known specimen.

Variations. Both of the paratype specimens have a slightly thinner head than the holotype, and whole body concolorous brown instead of dark brown. Presently, we deal

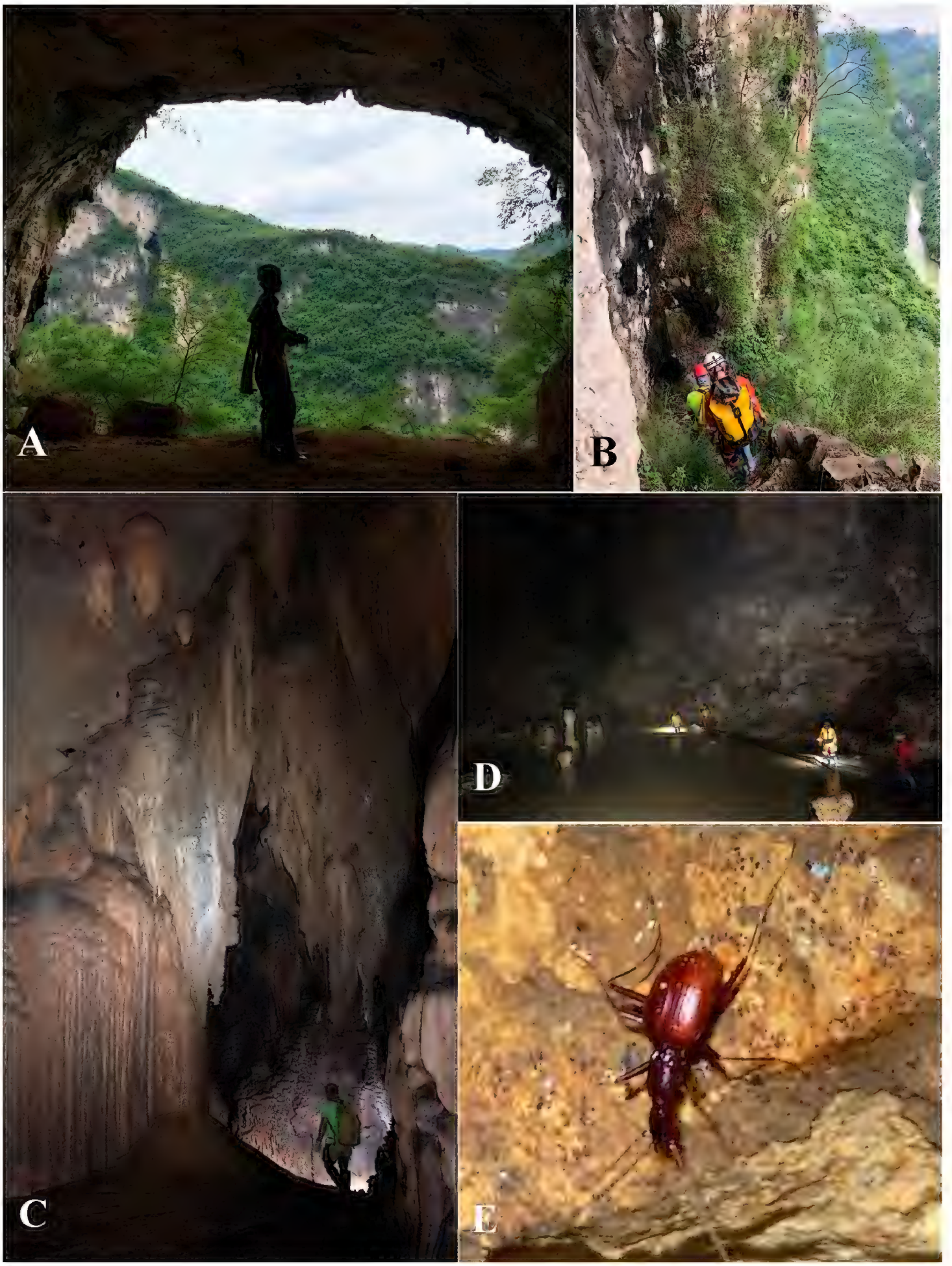

Figure 6. Dawan Dong cave, the type locality of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov. **A, B** Entrances and environs **C, D** scenes inside the cave **E** a running individual of *H. jinxiaohongae* sp. nov. in the cave, courtesy of Mr Chenggang Wang.

with the differences as individual variations regarding the facts that the similarities of morphological and genital structures, and the caves Dawan Dong and Changtu Dong are close to each other. Molecular analysis would be helpful to clarify their relationship.

Distribution. China (Guizhou). Known from two limestone caves: Dawan Dong and Changtu Dong in the suburb of Guiyang (Fig. 1).

Located in the northern most part of Qingzhen Shi, about 45 km from the main town, Dawan Dong (Fig. 6A) in openings of a cliff of the Maotiaohe valley, on the western side of the river (Fig. 6B). This beautiful cave is 2026 m long, 10–30 m wide and 10–50 m high (Zhao Fei, pers. comm.), with large galleries and several huge chambers (Fig. 6C, D). The single specimen was found running on the ground in a moist and dark area about 500 m from the entrance (Fig. 6 E). Other cave invertebrates found in this cave were woodlice, harvestmen and crickets.

Cave Changtu Dong (Fig. 7) is located about 3.5 km from Dawan Dong in the west, and about half a kilometre from Ximi Village. The cave has two entrances, its length is still unknown. It has been badly impacted and not so pristine as Dawan Dong. Most of the main passage from the smaller entrance is wet and favourable for cave fauna (Fig. 7A, B). The single specimen of *H. jinxiaohongae* gen. nov., sp. nov. was collected together with harvestmen, moths, and millipedes of the genera *Pacidesmus* and *Glyphiulus* along the main passage (Fig. 7C–G).

Genus *Zhijinaphaenops* Uéno & Ran, 2002

Zhijinaphaenops zhaofeii sp. nov.

http://zoobank.org/4A45AFCB-A77F-41B0-A2E8-5E57CDCAFF35
(Chinese name: 赵飞盲步甲)
Figures 8, 9A, E, 10A, B, 11

Type material. ***Holotype*** male: Guizhou, Guiyang, Xifeng, Jiuzhuang, Changtu Dong cave (贵州省贵阳市息烽县九庄镇张口洞), 27°11'N, 106°29'E, 1008 m, 2019–VI–08, leg. Jingli Cheng & Mingyi Tian.

Diagnosis. A medium-sized *Zhijinaphaenops* species, body concolorous reddish brown, antennae very long, extending over elytral apices.

Description. Length: 5.8 mm (including mandibles); width: 1.7 mm. Habitus as in Figure 8.

Body reddish brown, palps and tarsi pale. Head covered with sparse and short hairs, whole disc of pronotum covered with dense and long setae; elytra densely pubescent, except glabrous at apical portion; genae, ventral head and prosternum with a few setae; meso- and metasterna and hind coxae dense setose; abdominal ventrites covered with dense and short pubescence.

Microsculptural engraved meshes isodiametric on labrum and base of frons, moderately transverse on vertex and more or less transversally striate on pronotum and elytra. Elytra rather stout, fore body (including mandibles) as long as elytra.

Head (Fig. 9A) moderately elongated, distinctly longer than wide, HLm/HW = 2.25, HLl/HW = 1.66; widest at about middle; sub-parallel-sided, frons and ver-

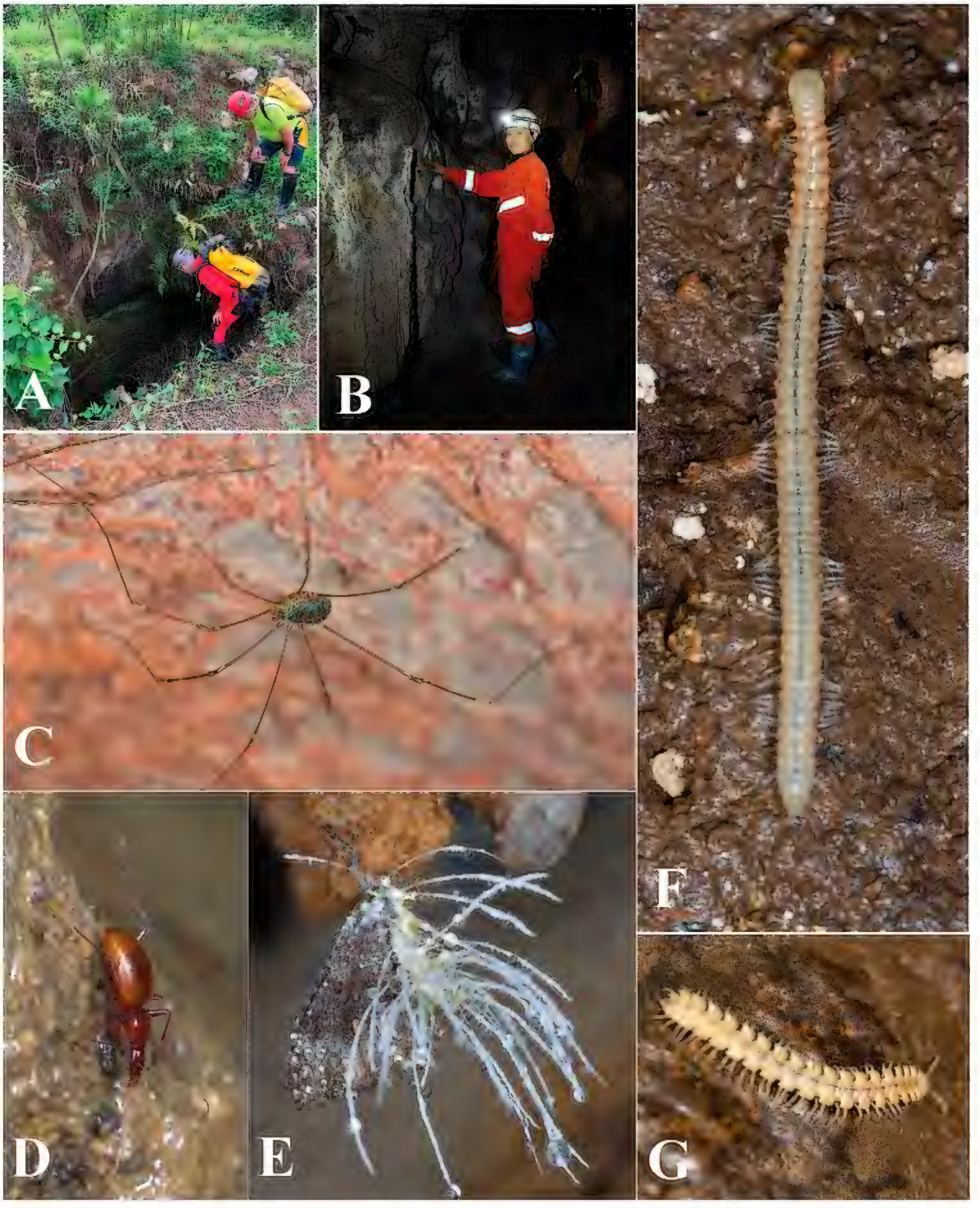

Figure 7. Changtu Dong cave, another locality of *Haixiaphaenops jinxiaohongae* gen. nov., sp. nov. **A** one of the entrances **B** Xiaohong Jin is collecting in the cave **C** a harvestman **D** a running individual of *H. jinxiaohongae* gen. nov., sp. nov. **E** *Cordyceps* fungus growing on a *Triphosa* moth **F** millipede *Glyphiulus* sp. **G** millipede *Pacidesmus* sp.

tex moderately convex; frontal furrows nearly parallel-sided in anterior 2/3, then strongly divergent posteriad, ending before posterior supraorbital pores; anterior supraorbital pores absent; clypeus transverse, 6-setose; labrum transverse, front margin shallowly bisinuate, 6-setose; mandibles thickened, feebly unciform at apex, right

Figure 8. Habitus of *Zhijinaphaenops zhaofeii* sp. nov., holotype, male.

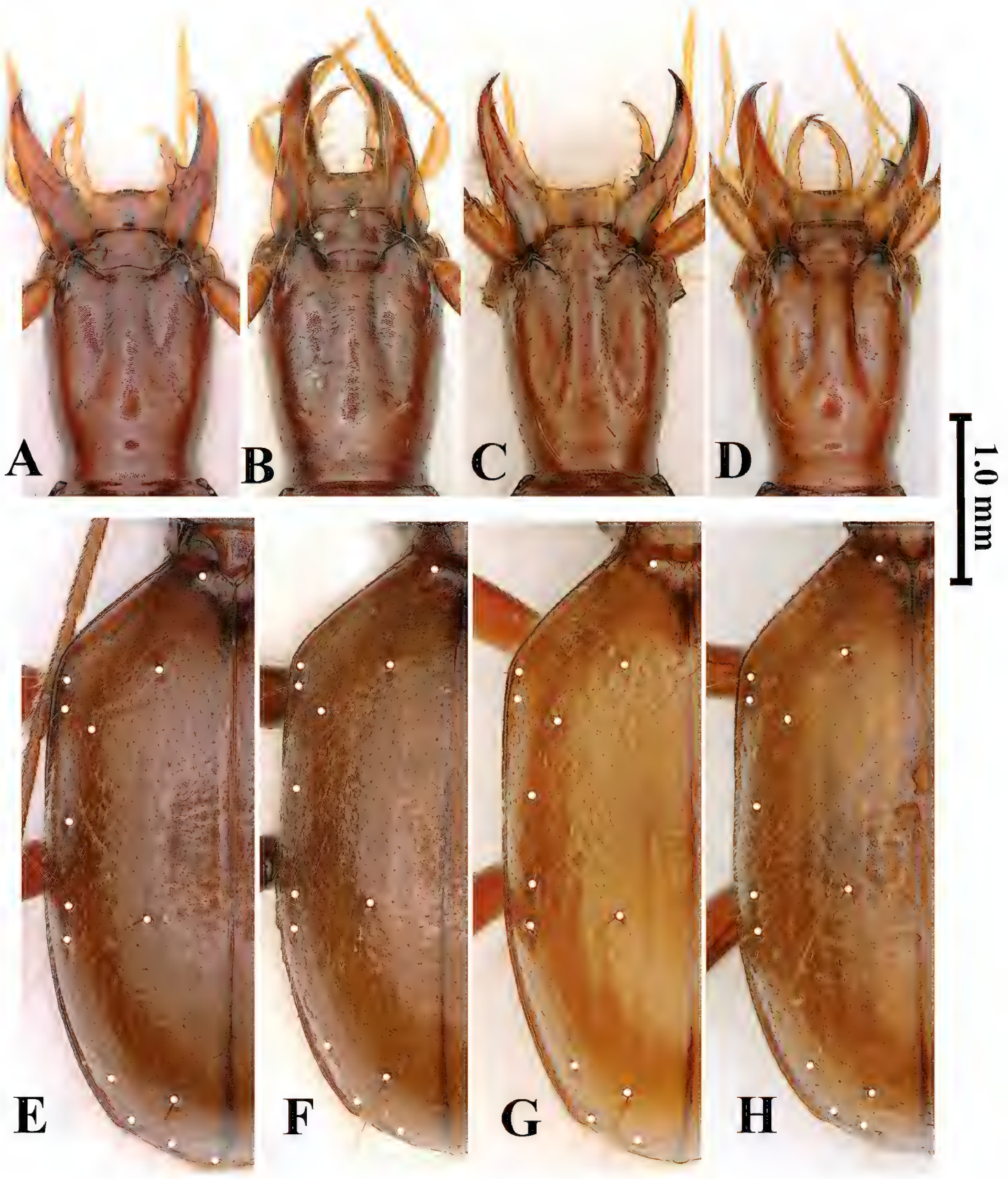

Figure 9. Head (**A–D**) and elytral chaetotaxy (**E–H**) of *Zhijinaphaenops* species **A, E** *Z. zhaofeii* sp. nov. **B–D**, **F–H** *Z. jingliae* **B, F** from Zhangkou Dong in Musan, type locality **C, G** from Mafen Dong **D, H** from Wenquan Dong. Scale bar: 1.0 mm (**A–H**).

mandibular tooth bidentate; labial suture completely disappeared; mentum 2-setose, base widely concave, tooth short, thin and bifid at tip; submentum 9-setose; ligula 2-setose at apex; palpomeres moderately long and slender, glabrous except 2nd labial palpomere bisetose on inner margin, with an additional seta on outer margin near apex; 2nd labial palpomere 1.15 times as long as 3rd, whereas 3rd maxillary one 1.20 times longer than 4th; suborbital setae close to base of head; antennae slender

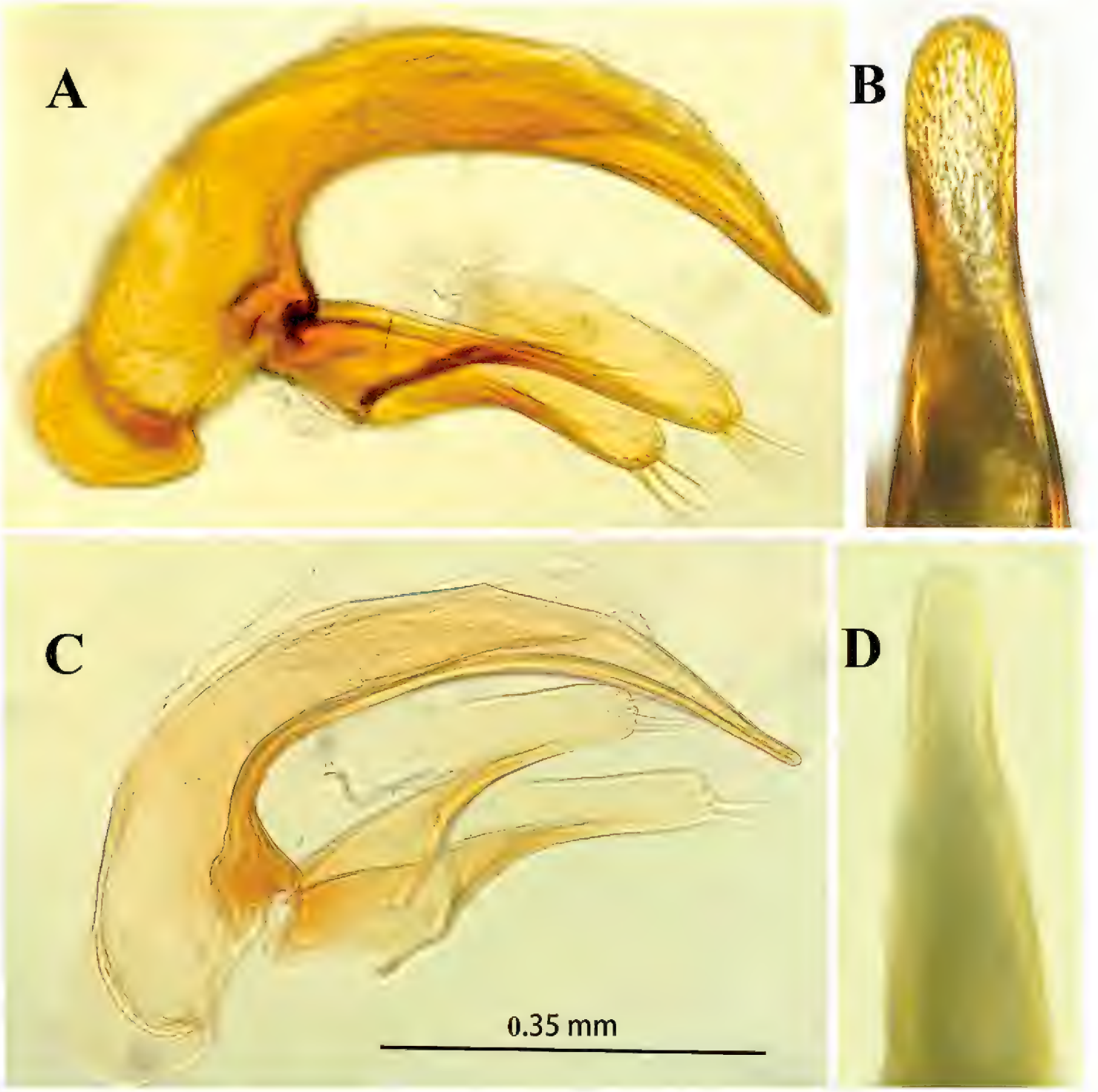

Figure 10. Male genitalia of *Zhijinaphaenops* species, lateral view and apical lobe in dorsal view **A, B** *Z. zhaofeii* sp. nov. **C, D** *Z. jingliae* Deuve & Tian, 2015. Scale bar for **A–D**.

and elongate, 11th antennomere and part of 10th antennomere extending over elytral apices; scape thick, fusiform, with several rather long setae, pedicle the shortest; antennomeres densely pubescent from pedicle to 11th; 3rd antennomeres longest; relative length of each antennomere compared with pedicle in the holotype as follows: 1st (1.27), 2nd (1.00), 3rd (2.57), 4th (2.38), 5th (2.46), 6th (2.22), 7th (2.10), 8th (1.83), 9th (1.75), 10th (1.60) and 11th (1.89).

Prothorax longer than wide, PrL/PrW = 1.14; distinctly wider than pronotum, PrW/PnW = 1.19; shorter than head, PrL/HLm = 0.68, PrL/HLl = 0.92, propleura

strongly tumid, widest at about 2/5 from base. Pronotum wider than head, PnW/HW = 1.15; longer than wide, PnL/PnW = 1.35, sides bordered and reflexed throughout, more reflexed near base, widest at about 3/5 from base, more constricted anteriorly, gently contracted backwards, then shallowly sinuate before hind angles; fore angles obtuse, hind angles rectangular; base and front straight, unbordered, and subequal in width; anterior lateral setae at about 1/4 from front, posterior setae absent; disc slightly convex, basal foveae large and deep. Scutellum moderate in size.

Elytra (Fig. 9E) elongated ovate, strongly convex though lateral margins visible throughout from above; much wider than prothorax, EW/PrW = 1.88, much longer than wide, EL/EW = 1.64, widest at about middle; humeral angles broadly rounded; lateral margins finely bordered throughout, smooth, not ciliate; base unbordered, apical striole absent; striae not easily traceable; intervals faintly convex; chaetotaxy (Fig. 9E), anterior discal pore located at about basal 1/6 of elytra, posterior one at about apical 2/5 of elytra; 7th and 8th pores well marked; angulo-apical pore present.

Legs rather long for a *Zhijinaphaenops* species, fore and middle tibiae longitudinally furrowed; the 1st protarsomere in male elongated and widened, denticulate on inner side of apex; 1st tarsomere as long as 2nd–4th tarsomeres combined in all legs.

Ventrites IV with 2 pairs, V and VI each with 3 pairs of paramedial setae, VII 6-setose apically.

Male genitalia (Fig. 10A, B): Median lobe of aedeagus short, moderately sclerotized, with a large sagittal aileron and a large and elongated copulatory piece which is about 1/4 of median lobe in length; ventral margin strongly sinuate, then tapering toward apex which is blunt; base opening rather narrow, apical lobe narrow, much longer than wide, broadly rounded at apex; parameres long and broadly widened, but shorter than median lobe, each with 3 long setae at apex.

Female: unknown.

Remarks. Similar to *Zhijinaphaenops jingliae* Deuve & Tian, 2015, but *Z. zhaofeii* sp. nov. differs in having a wider head, with labrum bisinuate instead of nearly straight, mandibles less hooked at tips and a median lobe with a broader apex in dorsal view.

Etymology. In honor of Mr Fei Zhao, a young active caver in Guiyang.

Distribution. China (Guizhou). Known only from limestone cave Zhangkou Dong, in the suburb of Guiyang (Fig. 1).

Located in the northwestern part of Xifeng County, Zhangkou Dong (Fig. 11) on the southern bank of the Wujiang River. The entrance (Fig. 11A) is close to the main road from Jiuzhuang town to the dock. The passage goes obliquely down to the inner part of the cave, with a small creek inside. It is a rather beautiful cave, but partly damaged by the villagers. The habitat remains favourable for cave animals (Fig. 11B, C). The single beetle was found under a stone in a muddy area about 100 m from the entrance (Fig. 11D). Other cave invertebrates found in this cave were millipedes of *Pacidesmus* and *Glyphiulus* (Fig. 11E, F), a mite (Fig. 11G), moths and crickets.

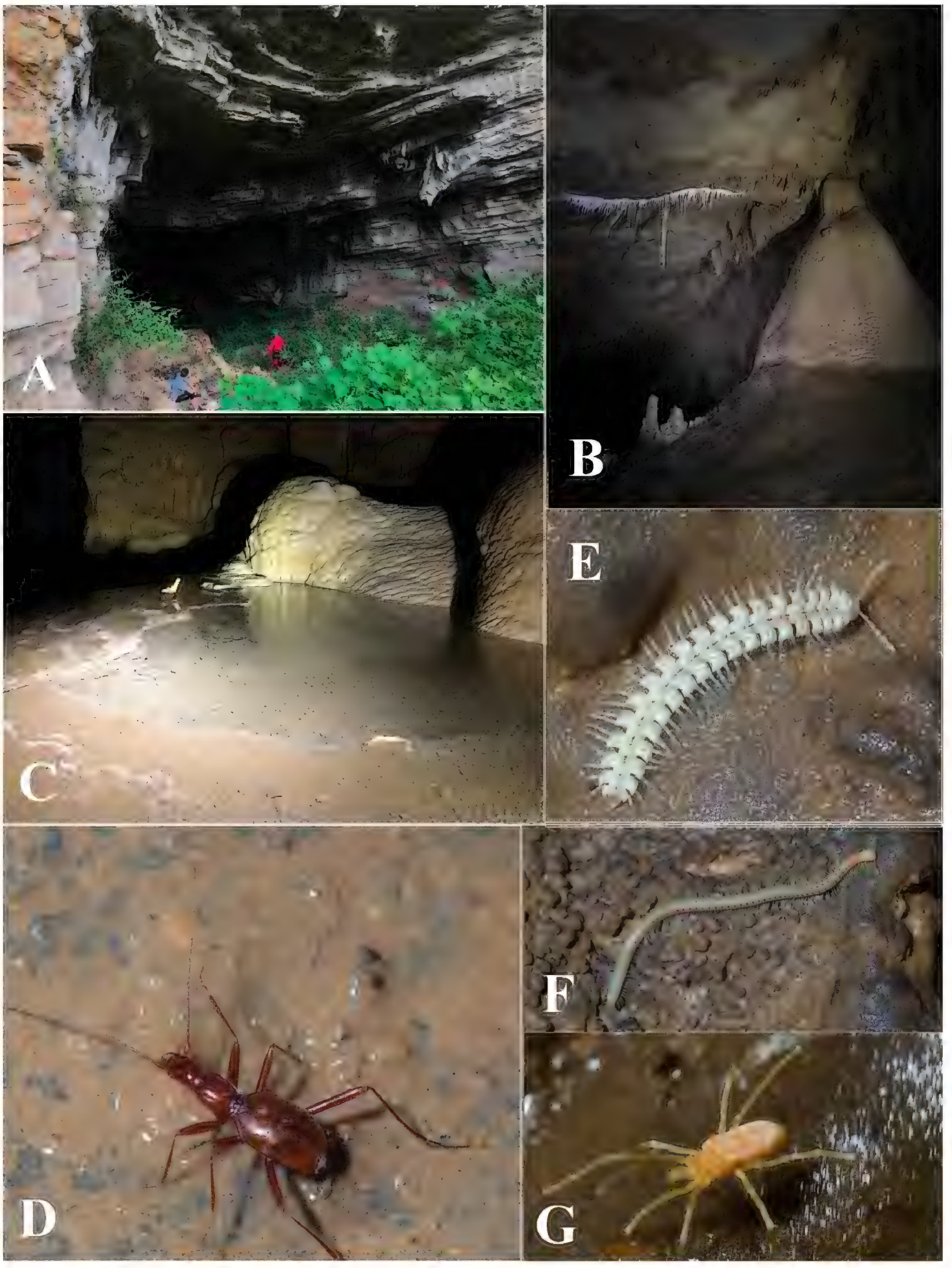

Figure 11. Zhangkou Dong cave, type locality of *Zhijinaphaenops zhaofeii* sp. nov. **A** entrance **B, C** scenes inside the cave **D** a running individual of *Zhijinaphaenops zhaofeii* sp. nov. **E** millipede *Pacidesmus* sp. **F** millipede *Glyphiulus* sp. **G** a mite.

***Zhijinaphaenops jingliae* Deuve & Tian, 2015**
(Chinese name: 景丽织盲步甲)
Figures 1, 9B–D, F–H, 10C, D, 12, 13

Zhijinaphaenops jingliae Deuve & Tian, 2015: 397

Material. 2 males & 1 female, Guizhou: Guiyang, Xifeng, Xishan, Shenli, Mafen Dong cave (息烽县西山镇马粪洞), 27°04'N, 106°37'E, 1157 m, 2020–II–29, leg. Guangyuan Cheng; 1 male, Guizhou, Guiyang, Xifeng, Xinlong, Wenquan Dong (息烽县温泉镇温泉洞), 27°11'N, 106°49'E, 916 m, 2020–VII–18, leg. Jingli Cheng.

Diagnosis. A medium-sized *Zhijinaphaenops* species, wholly brown and pubescent, head narrow, with thin and very long antennae which extend beyond of elytral apices. Habitus as in Figure 12 A.

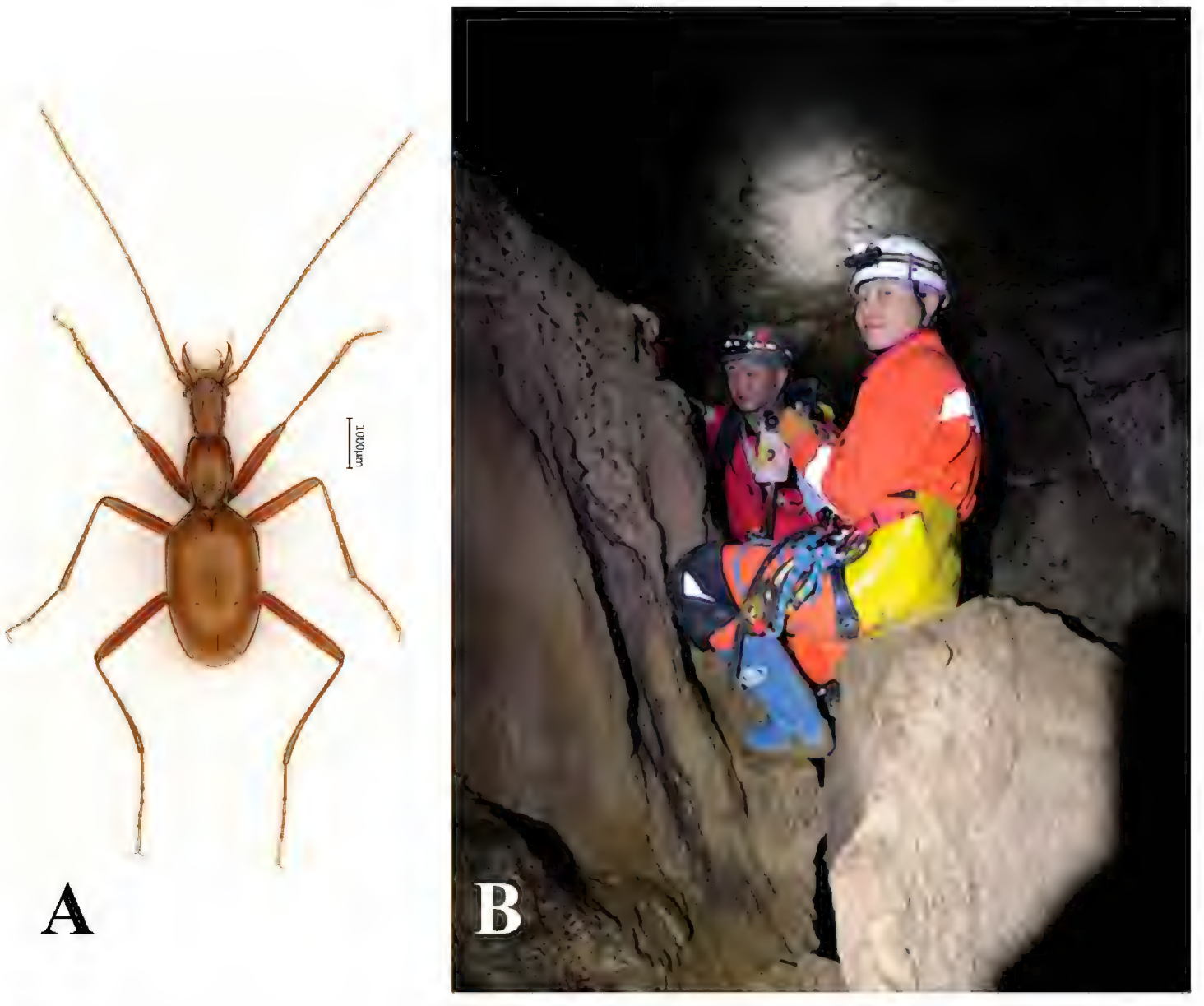

Figure 12. Mafen Dong cave, a new locality of *Zhijinaphaenops jingliae* Deuve & Tian, 2015 **A** habitus of a male beetle discovered in Mafen Dong **B** place where beetles were discovered.

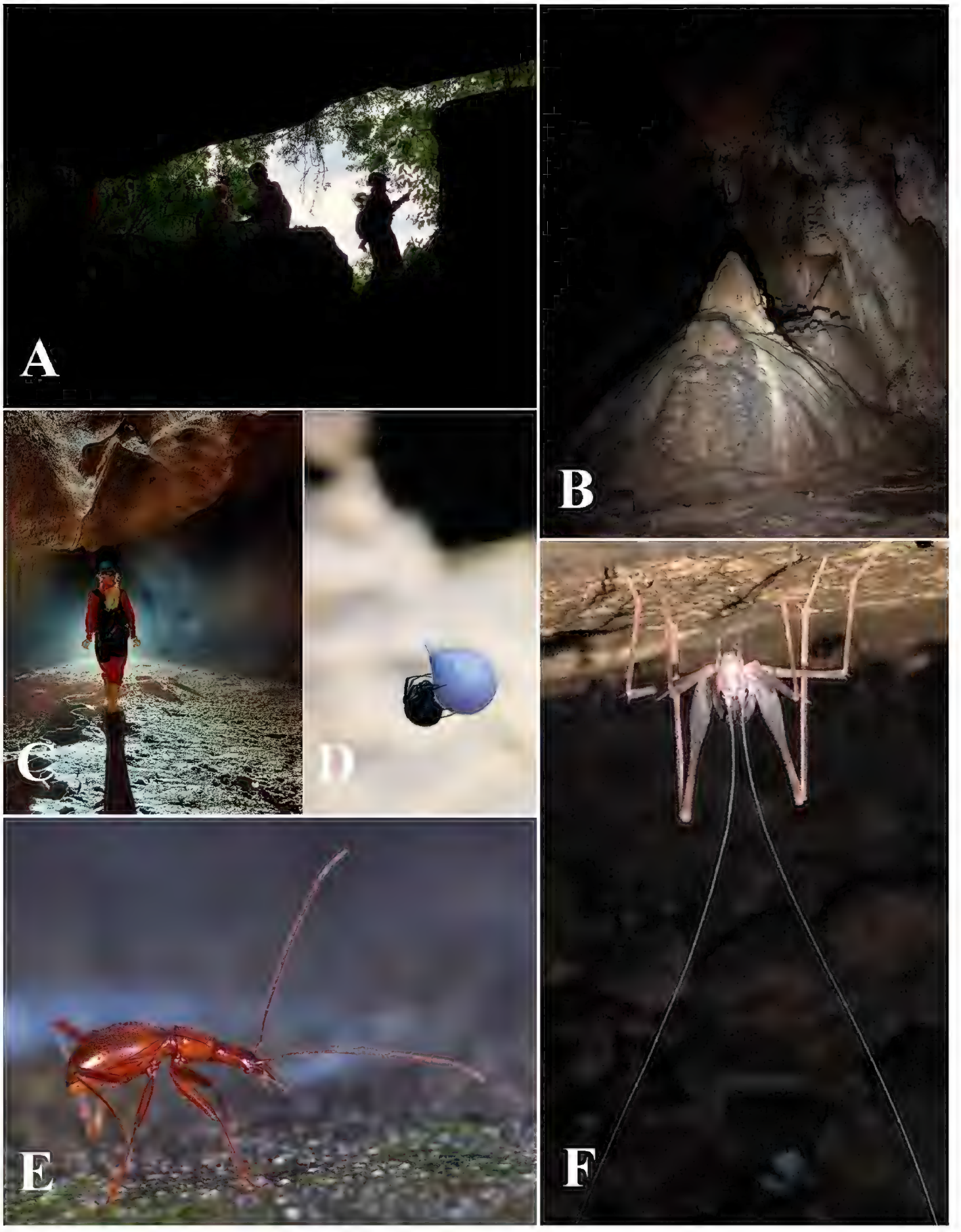

Figure 13. Wenquan Dong cave, a locality of *Zhijinaphaenops jingliae* Deuve & Tian, 2015 and its sympatric arthropods **A** entrance **B, C** environ inside cave **D** a spider with an egg sac **E** a running individual of *Z. jingliae* **F** a *Tachycines* cricket.

Remarks. *Zhijinaphaenops jingliae* was recorded from Zhangkou Dong cave near Musa village, Shidong Zhen, Xifeng County (Deuve and Tian 2015). In 2020, this species was found in two caves of the same county, Mafen Dong (Xishan Zhen) and Wenquan Dong (Wenquan Zhen). Morphological characteristics including male genitalia of individuals from the above two caves are identical to the holotype specimen (Figs 9B–D, F–H, 10C, D).

Distribution. China (Guizhou). Known from three limestone caves in Xifeng County, northern Guiyang (Fig. 1).

Mafen Dong cave (Fig. 12B) is about 600 m from Mafen village, only 5 km away Zhangkou Dong cave in the east. The individuals of *Z. jingliae* were found running on the ground in a dark area not far from the entrance.

Wenquan Dong cave is near Xinglong village, about 30 km from Zhangkou Dong. It opens via quite large entrance in a small hill of a valley and is surrounded by bushes, (Fig. 13A). There are two large chambers inside and a main passage about two hundred meters long. There is a pool at the bottom of the first chamber. A large part of the cave is moist and maintains good conditions for cave animals (Fig. 13B, C). Apart from the single beetle of *Zhijinaphaenops jingliae*, other cave arthropod animals found in this cave were spiders and crickets (Fig. 13D–F).

Genus *Sinaphaenops* Uéno & Wang, 1991

Sinaphaenops chengguangyuani Ma et al. 2020

(Chinese name: 程广源华盲步甲)
Figures 1, 14, 15

Sinaphaenops chengguangyuani Ma et al. 2020: 582

Material. 1 male & 4 females, Guizhou, Guiyang, Nanming, Yunguan, Jianlonglu, Jianlong Dong cave (贵州省贵阳市南明区见龙洞), 26°32'N, 106°46'E, 1094 m, 2020–VI–26, leg. Guangyuan Cheng, Xiaohong Jin, Chenggang Wang, Yi Zhao & Mingyi Tian; 1 female & 1 male, Guizhou, Qiannan Miao & Buyi Autonomous Prefecture, Longli, Duocai Dong (贵州省黔南布依族苗族自治州龙里县多彩洞), 26°34‘N, 106°59‘E, 1555 m, 2021–VIII–14, leg. Guangyuan Cheng.

Distribution. China (Guizhou). Known from three limestone caves in Guiyang Shi and Longli County, Qiannan Buyi & Miao Autonomous Prefecture (Fig. 1).

This species was described from Shuijing Dong cave, Longli County, Qiannan Buyi & Miao Autonomous Prefecture (Ma et al. 2020). Then it was found in Jianlong Dong, Guiyang and Duocai Dong, Longli.

Jianlong Dong cave (Fig. 14) is located at the eastern suburb of Guiyang, about 40 km from Shuijing Dong, the type locality of *S. chengguangyuani*. This cave is a municipal protected area because of the engraved inscriptions on the precipices inside dating from

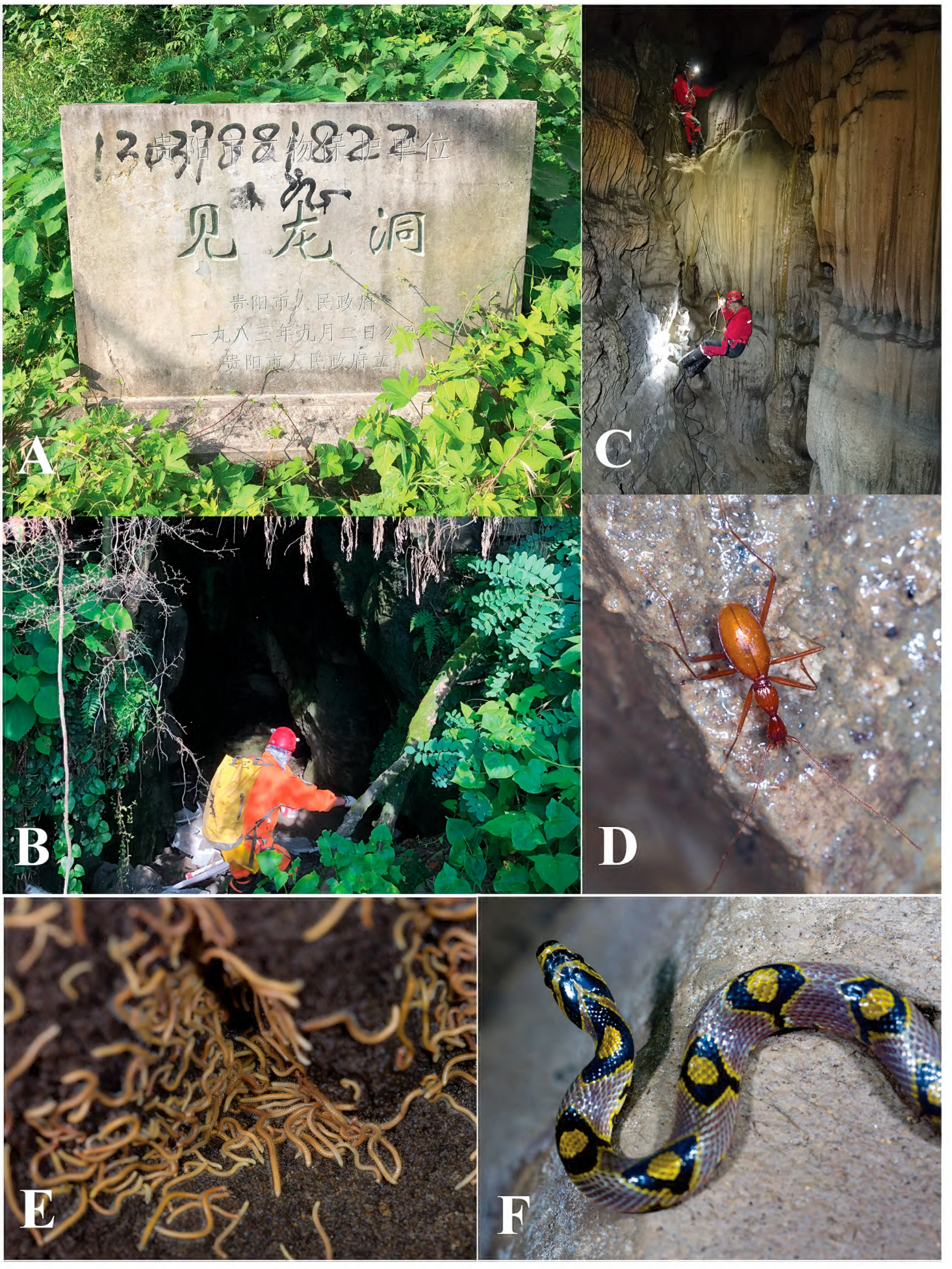

Figure 14. Jianlong Dong cave, a new locality of *Sinaphaenops chengguangyuani* Ma et al. 2020 **A** a monument indicating that the cave is under protection **B** entrance **C** stalagmites in the inner chamber **D** a running beetle of *S. chengguangyuani* **E** millipedes of *Glyphiulus* sp. **F** a snake *Elaphe mandarina* (Cantor, 1842).

Figure 15. A running individual of *Sinaphaenops chengguangyuani* Ma et al. 2020 inside Duocai Dong cave.

the Ming Dynasty, over 400 years ago (Fig. 14A). The rather large entrance is just on the side of the road Jianlonglu (Fig. 14B). The cave is about 100 m long, with two chambers inside. The first half part is rather dry, then becomes wet in the inner part (Fig. 14C). All of the beetle individuals were collected in the inner part, running on the ground or on the wall. Other cave animals observed in this cave were millipedes (*Glyphiulus* sp., Fig. 14E), a snake (*Elaphe mandarina* Cantor, 1842; Fig. 14F), crickets and moths.

Duocai Dong is a stalagtite-rich cave, about 5 km from Shuijing Dong in straight line. The two individuals were collected in dark zone, running on the wall (Fig. 15).

Acknowledgements

First of all, we are grateful to Ms Xiaohong Jin, Mr Chenggang Wang (both are senior members of Haixia Caving, Guiyang) and Ms Yi Zhao (SCAU team member, Guangzhou) for their efforts and assistance during the biological surveys. We thank Mr Fei Zhao (an active caver in Guiyang) for providing useful information about caves Dawan Dong and Zhangkou Dong. We thank also Drs Arnaud Faille (Stuttgart State Museum of Natural History, Stuttgart), Igor A. Belousov and Ilya I. Kabak (All–Russian Institute of Plant Protection, St. Petersburg,) for their critical remarks and constructive suggestions to improve the quality of the manuscript.

This study was sponsored by a project of the National Foundation of Natural Science of China (NSFC, Grant no. 41871039).

References

Chen JJ, Tang MR, Yang PJ, Tian MY (2017). Contribution to the knowledge of the aphaenopsian genus *Sinaphaenops* Uéno et Wang, 1991 (Coleoptera: Carabidae: Trechini). Zootaxa 4227(1): 106–118. https://doi.org/10.11646/zootaxa.4227.1.6

Chen MZ, Huang SB, Tian MY (2020) A new species of the aphaenopsian genus *Sinaphaenops* Uéno and Wang, with notes on male genitalia of *S. orthogenys* Uéno (Coleoptera: Carabidae: Trechini). The Coleopterists Bulletin 74(2): 1–8. https://doi.org/10.1649/0010-065X-74.2.343

Deuve T, Tian MY (2014) Un nouveau Trechini aphénopsien dans l'ouest du Guizhou (Coleoptera, Caraboidea). Bulletin de la Société entomologique de France, 119(3): 319–322. https://doi.org/10.3406/bsef.2014.2448

Deuve T, Tian MY (2015) Trois nouveaux Trechidae troglobies anophtalmes des karsts du Guizhou et du Zhejiang, en Chine (Coleoptera, Caraboidea). Bulletin de la Société entomologique de France 120(3): 397–402. https://doi.org/10.3406/bsef.2015.2259

Deuve T, Tian MY (2018) Nouveaux Trechini cavernicoles du Guizhou nord-occidental des genres *Zhijinaphaenops* et *Guizhaphaenops* (Coleoptera, Trechidae). Bulletin de la Société Entomologique de France 123(3): 333–339. https://doi.org/10.32475/bsef_2039

Huang SB, Tian MY, Faille A (2020) Three new species of the aphaenopsian trechine genus *Pilosaphaenops* Deuve & Tian, 2008 from South China Karst (Coleoptera: Carabidae: Trechinae). Annales de la Société entomologique de France (N. S.) 56(3): 203–214. https://doi.org/10.1080/00379271.2020.1771203

Ma ZJ, Huang SB, Tian MY (2020) Two new species of cavernicolous trechines from central Guizhou and northwestern Guangxi, China (Coleoptera: Carabidae: Trechinae). Zootaxa 4861(4): 581–593. https://doi.org/10.11646/zootaxa.4861.4.6

Tian MY, Huang SB, Wang XH, Tang MR (2016) Contributions to the knowledge of subterranean trechine beetles in southern China's karsts: five new genera (Insecta: Coleoptera: Carabidae: Trechini). ZooKeys 564: 121–156. https://doi.org/10.3897/zookeys.564.6819

Tian MY, Chen MZ, Ma ZJ (2020) A new anophthalmic trechine genus and two new species from southern Guizhou, China (Coleoptera: Carabidae: Trechini). Zootaxa 4766(4): 575–587. https://doi.org/10.11646/zootaxa.4766.4.4

Tian MY, Huang SB, Ma ZJ (2021) Two remarkable new genera and species of cavernicolous ground beetles from Guizhou Province, southwestern China (Coleoptera: Carabidae: Trechinae). Annales de la Société entomologique de France (N.S.), 57(2): 165–172. https://doi.org/10.1080/00379271.2021.1881917

Uéno SI (2002) New *Sinaphaenops* (Coleoptera, Trechinae) from southern Guizhou, with notes on *Thaumastaphaenops pulcherrimus*. Elytra 30: 57–72.

Uéno SI, Wang FX (1991) Discovery of a highly specialized cave trechine (Carabidae, Trechinae) in Southeast China. Elytra 19(1): 127–135.

Uéno SI, Ran JC (1998) Notes on *Sinaphaenops* (Coleoptera, Trechinae), with descriptions of two new species. Elytra 26: 51–59.

Uéno SI, Ran JC (2002) A new genus with three new species of aphaenopsoid trechine beetles (Coleoptera, Trechinae) from Western Guizhou, South China. Journal of the speleological Society of Japan 27: 42–59.